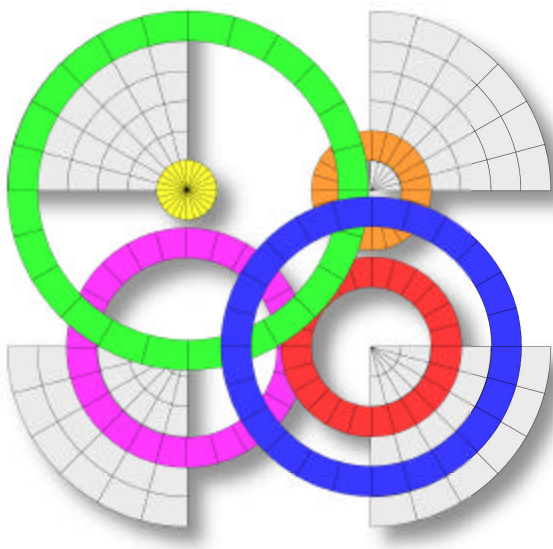




# An Energy Efficiency Workshop & Exposition

Kansas City, Missouri



## ***Energy Controls for Integrated Building Services***

***Jay Bayne, PhD***

***VP Technology, Johnson Controls, Inc.***

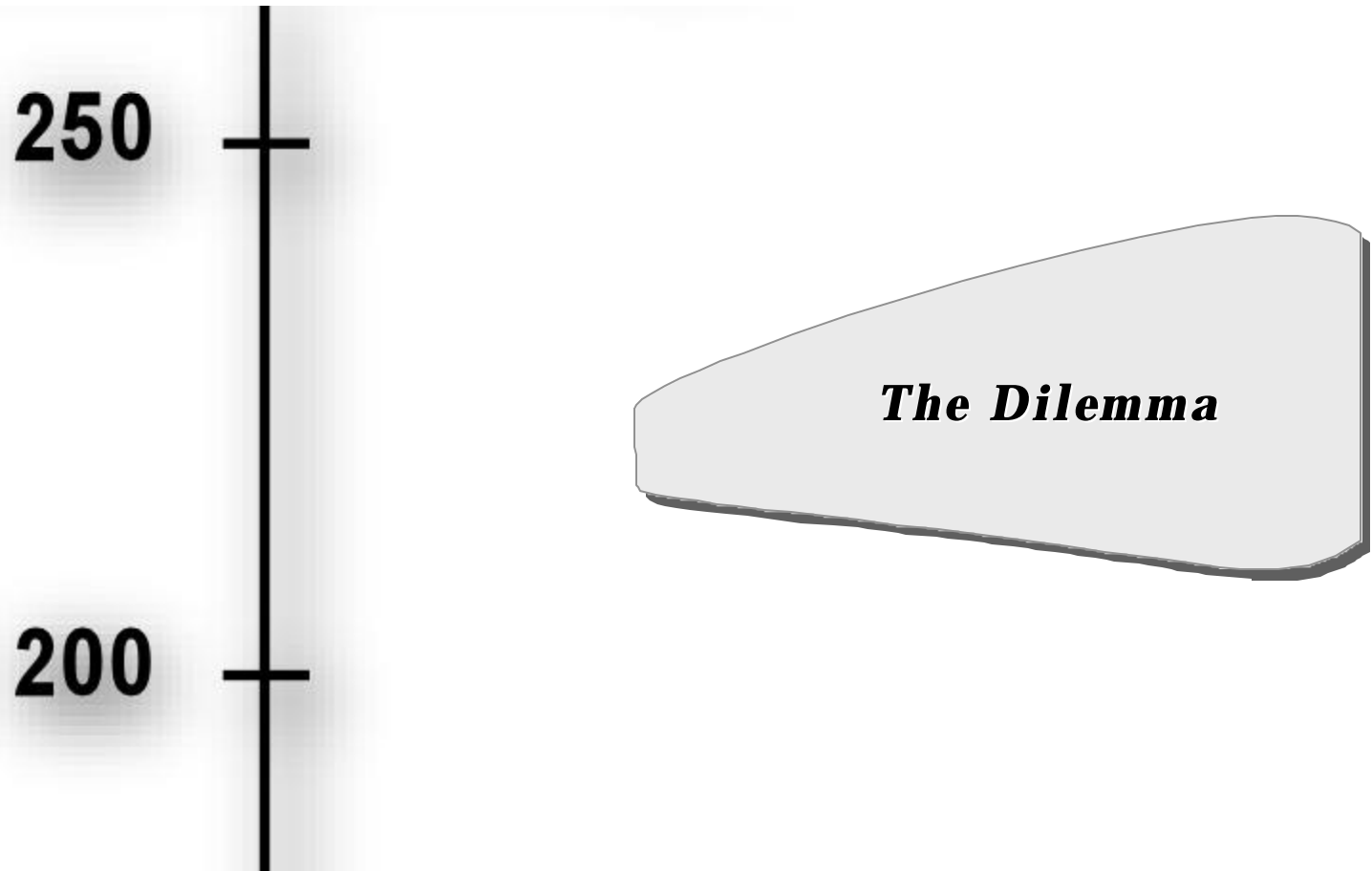
***[jay.bayne@jci.com](mailto:jay.bayne@jci.com)***

**Tuesday, June 4<sup>th</sup>, Session 4**

**Controls to Reduce Energy Use & Improve Power Quality**

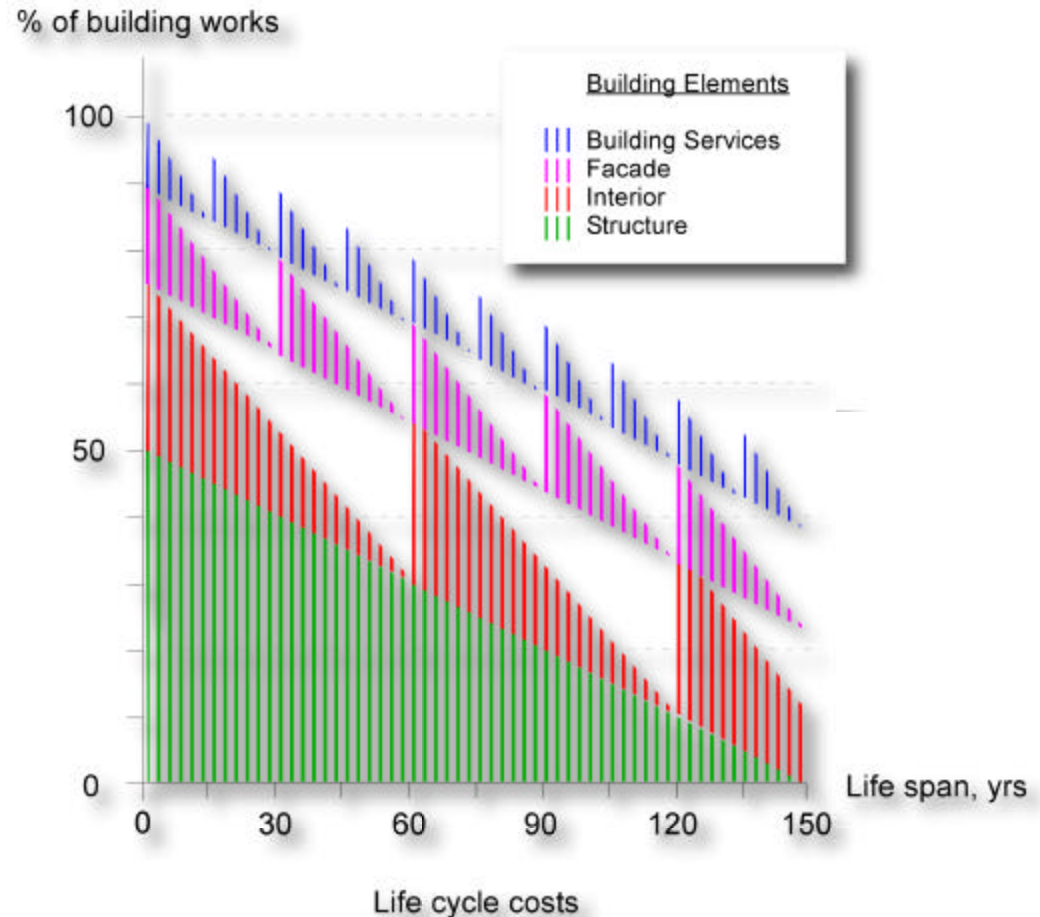
# *Energy Use Projections*

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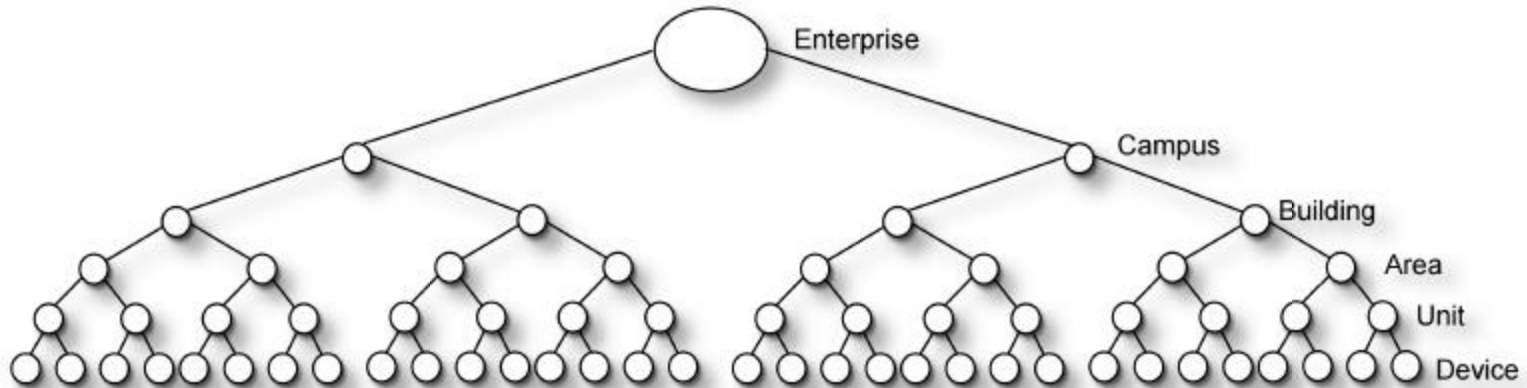


The Controls Division of Johnson Controls provides commercial distributed **control systems** providing integrated building services.

These control systems include technical **platforms** and control **applications** for the regulation of conditions related to energy, climate, access, security, life safety, lifts, and lighting within and across commercial enterprises.

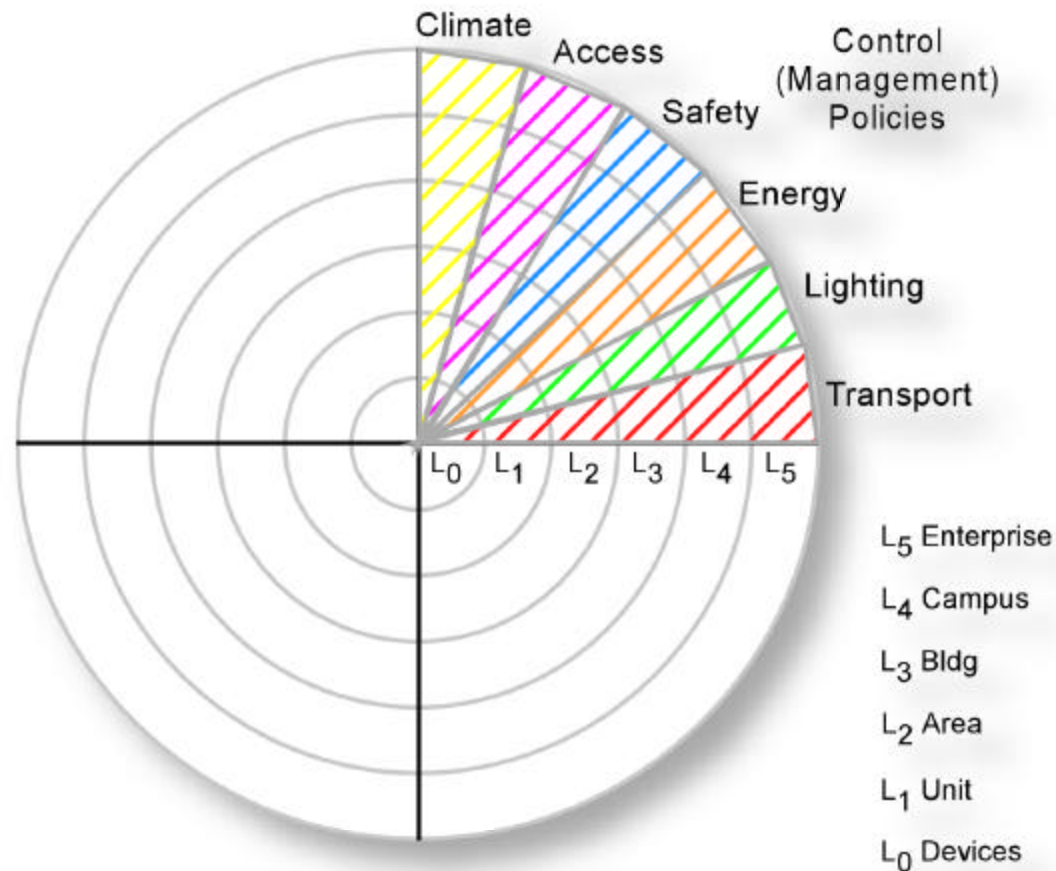


# Fundamental Axioms of Control



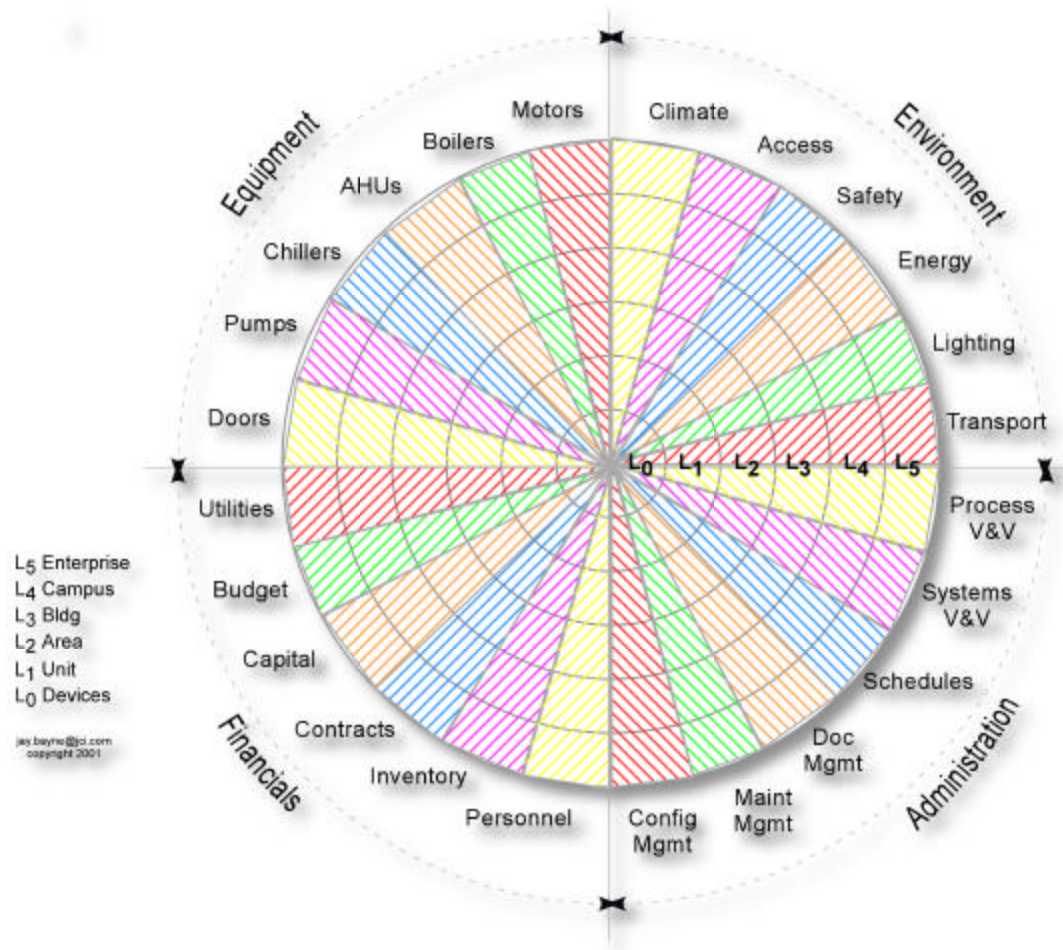
- Axiom 1:** Systems are always embedded in higher-order [meta-]systems.
- Axiom 2:** What is optimal control at one level may indeed be sub-optimal when viewed from a higher level.
- Axiom 3:** Integration of control and automation systems may occur horizontally and/or vertically.
- Axiom 4:** Integrated controls depend on reliable communications with well-defined protocols between and among elements on a given level, and elements on adjacent levels.
- Axiom 5:** A viable (i.e., dynamically stable) system must be flexible and adaptable, given that the environment in which it operates continually changes, and given its costs must be amortized over long periods.
- Axiom 6:** Viable systems must be reflexive, knowing their own states and behaviors, in order to support diagnostics, predictive maintenance, graceful degradation, and self-repair.
- Axiom 7:** Systems are integrated only when they share a common language (syntax), and agree on the meaning (semantics) of messages they interchange which act as selectors of behavior.

# Asset Control Domains



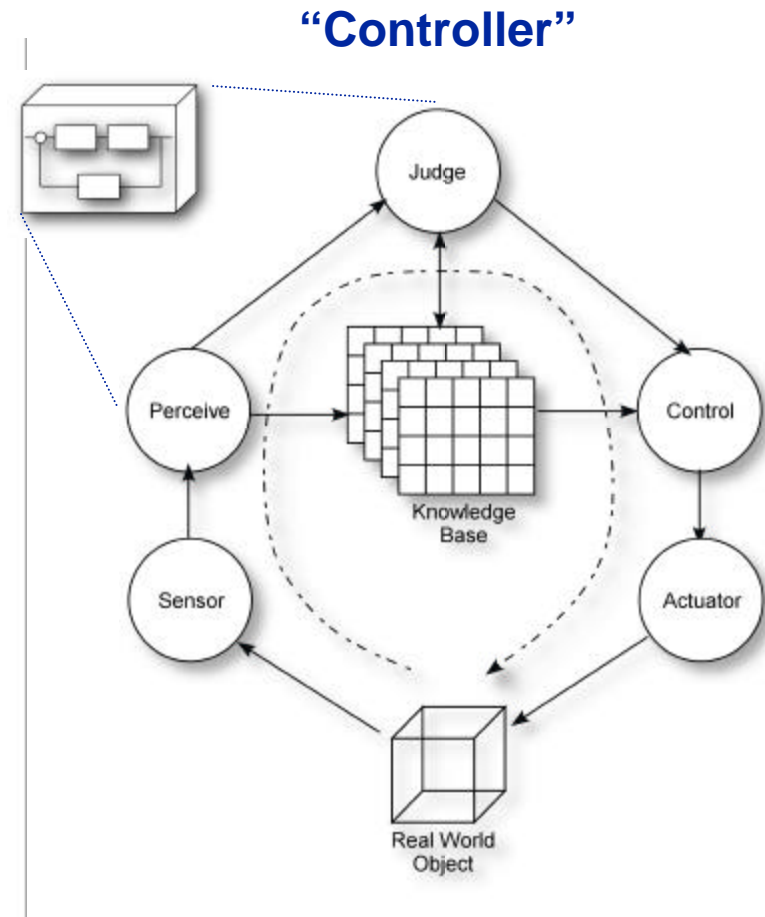
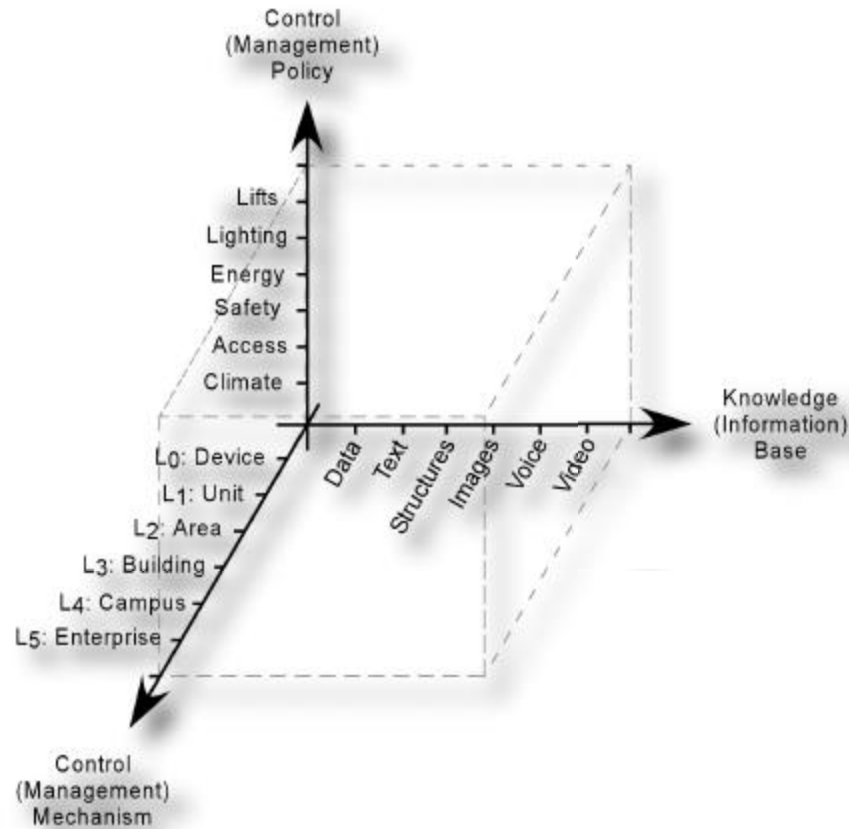
$$\text{energy\_use} = f(\text{climate, lighting, transport, access, safety})$$

# Integrated Building Systems

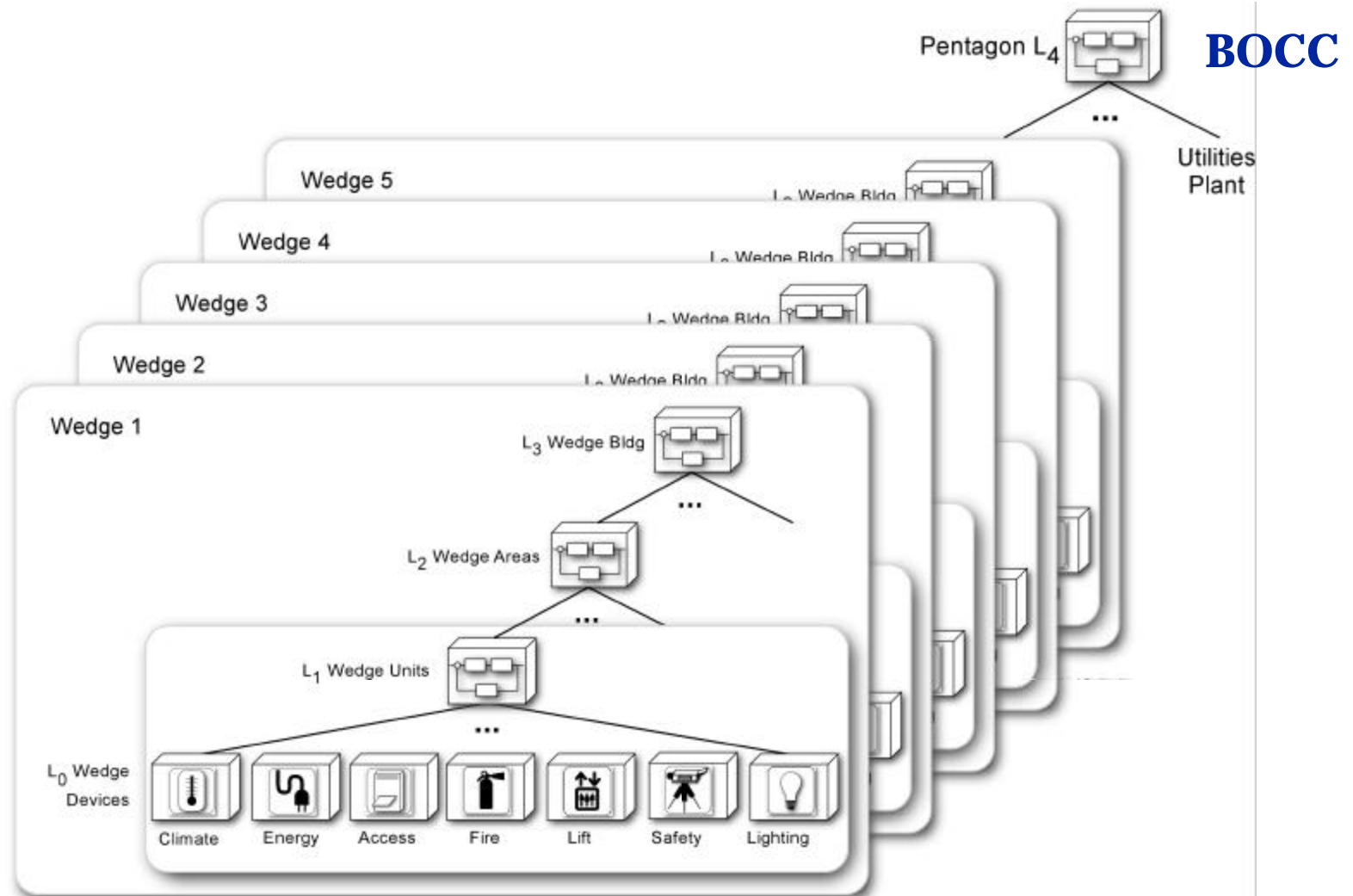




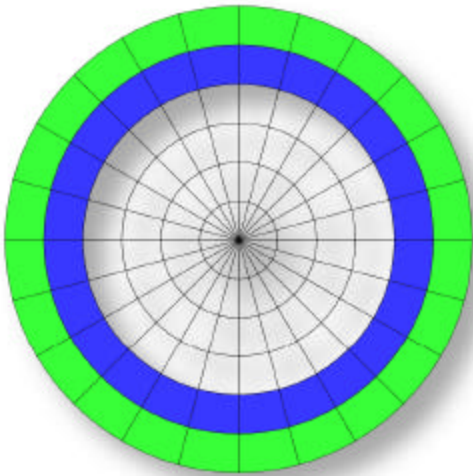
# Controller: Policy Enforcement



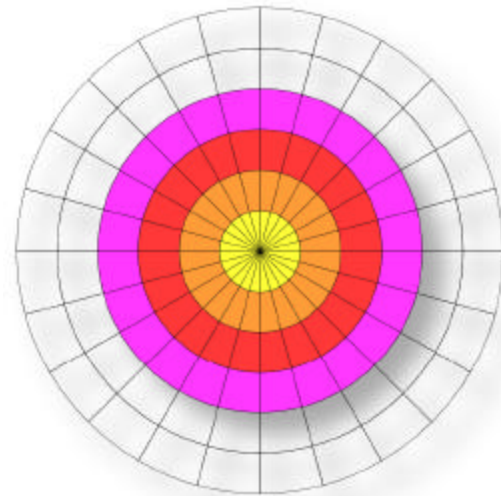
# Example: The Pentagon





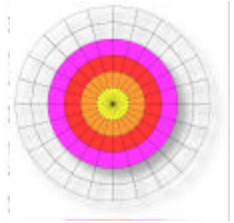
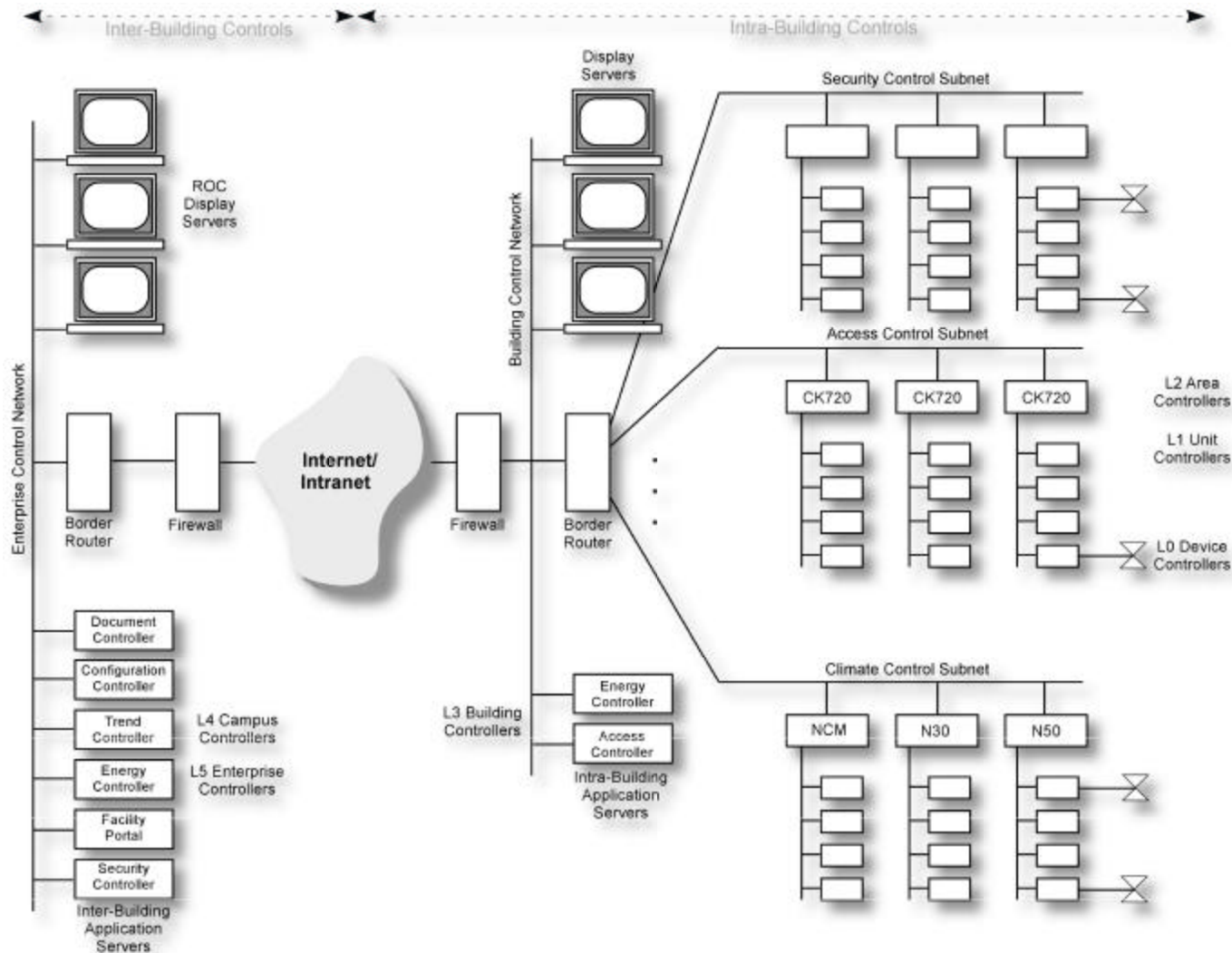


**Intra-Building Controls  
(Traditional BAS)**



**Inter-Building Controls  
(Remote Operations)**

# Controls Infrastructure



# Integrated Energy Controls

